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it involves no new principle, is, I believe, in detail perfectly original.

The Level, the value of whose divisions was to be determined, was in the first place lashed securely to the declination circle of my Equatoreal. The micrometer having been screwed into the eye end of the telescope, the wires were separated by some known number of seconds of arc. The instrument being now firmly clamped in the meridian, the telescope was so adjusted that a star not very far from the equator should, during its transit, run along and be threaded by the *top* wire of the micrometer. Just before the star entered the field the level was carefully read. As the star approached the middle of the field the telescope was depressed by means of the tangent screw of the declination circle, until the star ran along the *bottom* wire of the micrometer, whereupon the level was again read immediately. The number of seconds of arc through which the telescope, declination circle, and level, had been moved, was of course that of the interval between the micrometer wires, and this, divided by the number of divisions passed over by the level bubble, gave the value of one division.

The possessor of a large meridian circle would doubtless find that the ordinary mode of lashing his level to this circle and of reading the arc passed over by means of the circle microscopes, would be more accurate and expeditious; but to those who like myself possess only an Equatoreal, I would commend my method as susceptible of very considerable precision.

I may, in conclusion, mention merely as a fact, without attempting to account for it, that I invariably obtained a larger value for the divisions of the level scale from daylight observations, than I did from those made at night.

Forest Lodge, Maresfield, Sussex,
November 12th, 1862.

Results of the Meridional Observations of Small Planets; Occultations of Stars by the Moon; and Occultation of Jupiter's Second Satellites; observed at the Royal Observatory, Greenwich, in October and November, 1862.

(*Communicated by the Astronomer Royal.*)

Themis ㉔.

Mean Solar Time of Observation.		R.A. from Observation.	N.P.D. from Observation.
	h m s	h m s	° ′ ″
1862, Oct. 29	13 3 52·2	3 36 15·10	70 21 4·09
Nov. 27	10 46 17·8	3 12 38·23	71 40 47·37

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Iris ⑦.

Mean Solar Time of Observation.		R.A. from Observation.	N.P.D. from Observation.
	h m s	h m s	° ′ ″
1862, Oct. 3	9 57 43·1	22 47 5·02	86 16 41·77
9	9 31 39·9	22 44 36·92	86 54 20·02
10	9 27 26·6	22 44 19·41	87 0 17·11
11	9 23 14·9	22 44 3·59	87 6 8·46
14	9 10 53·1	22 43 29·46	87 22 56·42
16	9 2 49·2	22 43 17·35	87 33 26·04
18	8 54 54·2	22 43 14·12	87 43 17·15
24	8 32 1·9	22 43 57·37	88 8 53·89
29	8 13 58·5	22 45 33·81	88 24 59·68
31	8 7 0·2	22 46 27·44	88 30 1·89
Nov. 3	7 56 48·3	22 48 3·55	88 35 58·61
10	7 34 9·2	22 52 56·64	88 42 33·16
12	7 27 57·7	22 54 37·17	88 12 34·85
17	7 12 59·5	22 59 19·34	88 38 56·13

Pomona ㉜.

Mean Solar Time of Observation.		R.A. from Observation.	N.P.D. from Observation.
	h m s	h m s	° ′ ″
1862, Oct. 3	11 29 51·4	0 19 28·51	82 54 34·44
18	10 19 41·1	0 8 14·99	84 39 36·75
20	10 10 33·4	0 6 58·84	84 52 46·23

Aglaia ㊼.

Mean Solar Time of Observation.		R.A. from Observation.	N.P.D. from Observation.
	h m s	h m s	° ′ ″
1862, Oct. 3	11 55 31·7	0 45 12·98	83 57 44·08
24	10 16 19·6	0 28 32·23	85 4 20·05

Ausonia (63).

Mean Solar Time of Observation.		R.A. from Observation.	N.P.D. from Observation.
	h m s	h m s	° ′ ″
1862, Oct. 14	8 20 7·1	21 52 35·07	101 28 58·68
16	8 12 37·8	21 52 57·65	101 22 50·13

All the observations of N.P.D. have been corrected for refraction and parallax.

Occultations of Stars by the Moon.

Day of Observation.	Phenomenon.	Moon's Limb.	Mean Solar Time.	Observer.
1862.			h m s	
Oct. 11	κ′ Tauri, disapp.	Bright	13 32 56·2	E.
11	κ′ Tauri, reapp.	Dark	14 54 18·6	M.D.

The initials E. and M. D. are respectively those of Mr. Ellis and Mr. Dolman.

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On Nov. 24, Mr. Roberts observed the Reappearance after Occultation of *Jupiter's* Second Satellite. The last contact took place at $18^{h}\ 27^{m}\ 20^{s}{\cdot}4$ G.M.T.

The *Ann Arbor Astronomical Notices*, No. 28, contains a paper by Truman Henry Safford, Assistant at the Observatory of Harvard College, on the Proper Motion of *Sirius* in Declination.

The author in the first place refers to a paper by Dr. C. A. F. Peters, in the *Astronomische Nachrichten*, Nos. 745, 746, 747, on the Proper Motion of *Sirius* in Right Ascension; in which, by first comparing the observed Right Ascensions of α and β *Orionis* in different years with the tabulated Right Ascensions in the *Tabulæ Regiomontanæ*, and thence inferring the corrections to be made to observed places (a process which amounts to the same as supposing that the tabulated Right Ascensions are correct, or subject only to constant error), and applying those corrections to the observed Right Ascensions of *Sirius*, and comparing the corrected observed Right Ascensions of *Sirius* with the tabulated Right Ascensions of *Sirius* in the *Tabulæ Regiomontanæ*, a series of irregularities in the Right Ascensions of *Sirius* are found, which are numerically represented by the following hypothesis. That *Sirius* revolves in an elliptic orbit, on the law of gravitation, round an invisible companion; the time of passing the lower apse being the year 1791·431, the mean yearly motion $7^{\circ}{\cdot}1865$ (or periodic time 50·01 years), and the excentricity 0·7994: so that, putting u for the excentric anomaly at any time, the mean anomaly or $7^{\circ}{\cdot}1865\,(t - 1791{\cdot}431)$ will be equal to $u - 0{\cdot}7994 \,.\, \sin u$ (from which equation u is to be found); and the correction to the tabular place of *Sirius* will be

$$0^{s}{\cdot}127 + 0^{s}{\cdot}00050 \,.\, (t - 1800) + 0^{s}{\cdot}171 \,.\, \sin\,(u + 77^{\circ}\,41');$$

where $0^{s}{\cdot}127$ is a constant correction to the tabular Right Ascension, $0^{s}{\cdot}00050$ is a correction to the annual variation, and $0^{s}{\cdot}171$ and $77^{\circ}\,44'$ are constants depending on the magnitude of the major axis, its position, the position of the line of nodes of the orbit on the celestial sphere, and the inclination of the orbit to the celestial sphere.

The author then proceeds to treat the irregularities in the Declination of *Sirius* in the same manner. He uses the observations of Bradley (omits those of Maskelyne and Pond before 1822, because the thermometer coefficient is erroneous and he has not re-reduced the observations), uses Bessel 1820, Pond 1822, Struve 1824, Argelander 1830, Taylor 1832·5, Henderson (Cape) 1833, Maclear (Cape) 1834, Airy (Cam-

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bridge), Henderson (Edinburgh), Airy (12 year), Airy (6 year), Airy (later results), Busch (*Astr. Nach.* No. 422), Bond 1843, Moesta. Piazzi is omitted, as not sufficiently accurate. The author supports the exactitude of Bradley's result by comparison with Lacaille (1750) and Mayer (1756).

The stars of comparison employed are *α Virginis*, *α^2 Libræ*, *α Scorpii*, *α^2 Capricorni.* The tabular places are altered, when necessary, so as to introduce the constant of nutation 9″·22, instead of 8″·98 as in the *Tabulæ Regiomontanæ*, or 9″·65 as in the *Fundamenta Astronomiæ.*

The resulting irregularities in the declination of *Sirius*, now to be explained, are the following:—

	″		″		″
1755	−0·70	1833	−1·48	1843	+1·11
1820	−0·40	1834 (A)	−2·38	1844·5	+1·86
1822	−1·48	1834 (M)	−1·71	1850·8	+2·06
1824	−1·63	1837	−0·76	1855	+0·82
1830	−0·96	1838·5 (A)	−0·39	1856·5	+1·53
1832·5	−1·68	1838·5 (B)	−0·42		

No correction to mean places and mean annual variation destroys the periodicity of those terms, or even reduces the sum of squares of errors in a greater degree than from 33 to 25.

The author then proceeds to try the effect of introducing the same hypothesis as that found by M. Peters from the Right Ascensions; adopting the supposition of elliptic orbit, using the same time of passage of apse and the same excentricity, and determining the two constants still undetermined from comparison of the irregularities with the following formula:—

$$w + x\,(t - 1800) + y\,.\,\sin u + z\,.\,\cos u,$$

and finally obtains

$$0''\cdot 56 + 0''\cdot 0202\,(t - 1800) + 1''\cdot 47\,.\,\sin u + 0''\cdot 51\,.\,\cos u.$$

By introduction of this formula, the sum of squares of errors is reduced to one-eighth part of the least possible amount on the hypothesis of uniform motion.

It would seem, therefore, that great probability attaches to the hypothesis that, in the system of which *Sirius* is the only visible part, there is a large invisible mass present.

The greatest defect in the series of observations here treated is the lacuna between 1755 and 1820. A large part of this, perhaps, can never be supplied. The unfortunate introduction of Graham's quadrant destroys our confidence in the greater part of Bradley's results, and in Olufsen's corrections for the quadrant in subsequent years (which depend on Bradley). If, however, Bradley's later observations could be

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plausibly corrected, the observations of Maskelyne, treated by the method of comparison-stars, would give good instrumental results. No uncertainty, such as is produced by wearing of centre-work of the quadrant, attaches to Piazzi's or Pond's observations.

The correction of the refractions would be no very great work.

On the whole, we could wish that the able author of this paper could be induced to give to it all the completeness which existing materials can enable him to give. G. B. A.

On the Forms of Lenses proper for the Negative Eye-pieces of Telescopes. By G. B. Airy, Esq., Astronomer Royal.

In the *Monthly Notices* for June and November last, there are discussions on the forms of lenses proper for the Negative Eye-piece. Perhaps I shall not do wrong in stating to the Society that as long ago as the year 1827 I made a most elaborate investigation of the properties of Eye-pieces as depending on the curvatures of their surfaces. The paper is entitled "On the Spherical Aberration of the Eye-pieces of Telescopes," and is printed in the *Transactions of the Cambridge Philosophical Society*, vol. iii. This paper had been preceded by one "On the Chromatic Aberration of the Eye-pieces of Telescopes," from which I had been able to infer the proportions of the focal lengths and intervals of the lenses, which (independently of their curvatures) destroy colour at the sides of the field, using but one kind of glass; and had selected some of these as examples to which the formulæ for Spherical Aberration were to be applied. One of these is the Huyghenian Eye-piece, with the following very common proportions:—Focal length of first lens or field-glass = 3 M; focal length of second lens or eye-glass = M; interval between the two lenses = 2 M.

The principal results as applying to the cases before us are the following:—

First, as regards Distortion.

I must refer to page 15 of the Memoir for the general formula; but I may quote the following special results:—

(*a.*) It is possible to destroy Distortion entirely, but not by the use of common forms (equi-convex or plano-convex).

(*b.*) The most favourable combination of common lenses is,—the first, equi-convex; the second, plano-convex, with its convex side toward the first lens, or with its plane side next the eye.

Second, as regards Indistinctness at the edge of the field.

From the general formulæ in page 35 it appears that it is